

A STUDY OF SOCIAL IMPACTS OF GROUNDWATER OVERDRAFT IN THE SELECTED SUB-REGIONS OF HARYANA STATE

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Abstract

Water is a natural resource that is essential for human life, agriculture, and the development of sustainable communities. In Haryana District, one of the most important sources of water is ground water. Rainfall that occurs during monsoons and other seasons, as well as return flows from irrigation systems, recharge from canals, lakes, and ponds, and floods all help to replenish ground water resources. This annual recharging of the aquifer helps to contribute to the dynamic ground water resources. A large quantity of the ground water that is recharged into the aquifer is stored there, and a portion of it helps to provide base flow for the rivers. The term "static resource" refers to the vast quantity of ground water that continues to be stored in the aquifer below the zone of yearly fluctuation notwithstanding the annual recharge that takes place there. Due to the fact that out of the 33 blocks that make up the subregion, 22 are over-exploited, 4 are semi-critical, and 7 are critical in terms of their ground water status, there is an urgent need to increase the amount of ground water that is being recharged. This will allow for the annual amount of ground water that is being withdrawn to be balanced out. The purpose of this research paper is to investigate current changes in the amount of ground water found in the Haryana district as well as the social effects of groundwater overdrafts in the Haryana district. In addition to this the researcher has also suggest some measures to raise the ground water level in the Haryana Sub-Region.

Keywords : Ground water, Groundwater Overdraft, ground water recharge, groundwater management strategies

Introduction

Ground water is a key source of drinking water, irrigation water, and industrial development water in many regions of the world where there is a demand for water for these purposes. Ground water is one of the significant components of the worldwide fresh water resource (Singh and Sharma, 2010). Around the world, ground water meets approximately 50 percent of the demand for potable water, 40 percent of the demand for industrial water, and 20 percent of the need for water that is used for the irrigation of agricultural land (Villhoth, 2006). It is a resource that can be replenished, and it is distinguished by being an extremely dependable, safe, and sustainable source of water supply (Singh and Singh, 2002). Ground water is the most important source of irrigation and plays a critical role in ensuring the security of people's livelihoods all over the world, particularly in economies that are based on agriculture. Ground water is a finite resource (Mukherji and Shah, 2005). The majority of

agricultural ground water extraction comes from these four countries: India, Pakistan, Bangladesh, and China (Kaur et al; 2011). According to Shah et al. (2003), between 55 and 60 percent of the population of India relies, either directly or indirectly, on ground water for some aspect of their life. It is possible to understand the significance of ground water resource in India by considering the fact that nearly two fifths of all agricultural production is dependent on irrigation from ground water resources (CWC, 2013), and approximately sixty percent of all irrigated food production is dependent on irrigation from ground water resources (Central Water Commission, 2013). As a result, it is abundantly clear that there has been a considerable shift in the level of ground water, occurring over a variety of distinct time periods.

Review of Literature

Goel and Kumar (2003) reviewed the problem of the rising groundwater table in central and south western parts of Haryana and its management strategies. He observed that introduction of the canal system in southwestern part of Haryana is mainly responsible for enhancing water logging conditions and soil salinization due to rising water table. Though this problem has assumed a serious proportion yet it is possible to tackle it with care by reviewing the planning of canal system. Further, he discussed that afforestation with the use of saline irrigation water is helpful in lowering the water table by choosing certain plant species which draw more water and tolerate more salinity than agricultural crops.

Jeet (2001, 2010) established the high magnitude of groundwater depletion in Haryana and suggested various strategies for the management of this natural resource. Yadav (2010) described the trend of groundwater fluctuation in Rewari district of Haryana. He founded that water table is declining downward due to over exploitation of groundwater causing of failure of shallow tubewells.

According to a study on the exploitation of groundwater published by the Groundwater cell of Agriculture department, the maximum fall in water table has been noticed at 30.59 meters in the Mahendergarh and 18.33 meters in Gurgaon district during June 1974 to June 2010. Thus, the fast depleting Groundwater level in the fresh quality zones in Haryana has a critical appraisal of its present use.

STUDY AREA:

Haryana is a state in India that spans an area of 44,212 square kilometres and has a latitude that ranges from 27°39' to 30°56'N latitude and 74° 27' to 77°36'E longitudes. Approximately 1.40 percent of the entire land area of the country is taken up by it. The state is currently subdivided into 22 districts, each of which is overseen by one of four commissioners. The Shiwalik Hills to the north, the Yamuna River to the east, and the Ghaggar River to the north all serve as natural geographical boundaries for the state. The natural boundary between southern Delhi and the Gurgaon district is defined by the Aravalli Hills. This boundary also includes southern Delhi. The Thar Desert in Rajasthan can be found in the western part of the state. In the east, the state is bordered by Uttar Pradesh and Delhi; in the north by Punjab; in the northeast by Himachal Pradesh; and in the south and west by Rajasthan. As a result of its location in the interior of the Indian subcontinent, the climate in

Haryana is predominantly warm and semi-arid. The monsoon winds from the southwest are responsible for bringing here more than 75 percent of the total yearly rainfall during the months of July and September. The weather will be virtually completely dry from October through the end of June of the next year, with the exception of a few showers brought by western disturbances. The state receives an average of 560 millimetres of precipitation each year, however the amount can range anywhere from less than 300 millimetres in the south-western regions to more than 1000 millimetres in the mountainous tracks of the northeast. The state consistently suffers from a lack of available water resources. As a result, Haryana has a climate that is classified as subtropical continental monsoon, with distinct seasons and a wide temperature variation throughout the year. The intricacy of the region is reflected in the way the soils are distributed. Loamy soils make up a significant portion of the state's land area. These soils, which are often referred to as bangar soils, may be found throughout the state's northern and central regions. Khaddar soil is a type of silty loam soil that may be found all along the Yamuna River's path. Bet is the name given to the clayey silts that can be found along the courses of seasonal streams such as Ghaggar and Markanda. The most western region of the state is characterised by soils that range from sandy to loamy sand in texture. The sandy loam soils belt extends from the western district all the way down to the southern district. (Pandey et al. 2004).

Aim of the Study:

- * To study the recent trends in ground water level in Haryana district and Social Impacts of Groundwater Overdraft in Haryana district.
- * To suggest various groundwater management strategies to improve the Ground Water Table in Haryana Sub-Region.

Hypothesis of the Study

There is urgent need to increase the ground water recharge to compensate for the annual ground water withdrawal in the blocks of Haryana.

Research Methodology and Techniques

The research methodology employed is exploratory, interpretative, descriptive and analytical as well as evaluative, with the help of various data collection.

Data collection for Research Study

Both the primary and secondary sources have been listed to determine the nature, method and scope of this research work. Many other relevant critical works, periodicals, articles, reviews and other sources have been cited and referred to, whenever necessary.

For the purpose of determining the extent of groundwater depletion in southern Haryana, the research being carried out here makes use of both primary and secondary sources of information. In order to collect primary data, a comprehensive field survey was carried out on the attitudes of farmers on the installation of tubewells and the associated lowering problem, change in water table, change in cropping pattern, and so on. We are also interested in hearing the farmer's thoughts on the socio-economic ramifications of the decreasing water levels. A questionnaire has been created by the researcher in order to collect the necessary information

from the farmers. Concerning the falling water table, the cropping pattern, and the installation and operation of tubewells were among the topics included in the questionnaire, in addition to questions relating to socioeconomic factors. Six farmers from each block participated in the survey. The researcher interviewed a total of 200 farmers this manner, distributing themselves throughout 33 blocks and 9 different districts. Despite this, it is not impossible to find fault with the sample size that was chosen because it is impossible for such a small size to be adequate when compared to the enormous number of farms and tubewells in the area under study. Despite this, it was not practicable to survey every single farmer or village. As a result of the researcher having firsthand information that assisted in the process of locating sample farms, an effort has been made to reflect the highest possible level of representation. The secondary data on a variety of topics came from documents that have been published and those that have not been published by the Groundwater Cell of the Department of Agriculture of the Government of Haryana and the Central Groundwater Board in Chandigarh (Northern Region).

Discussions

Haryana's central ground water cell profile divides the state into three zones based on aquifer production potential. First, tube wells can yield 50 m³/hr in 26,090 sq. km in Sirsa, Hissar, Bhiwani, Mahendergarh, and Jind. The second zone covers Hissar, Kurukshetra, Karnal, Bhiwani, and Gurgaon, with tube wells that may yield 50-150 m³/hr. The third covers 9200 sq.km in Ambala, Kuruskshetra, Karnal, and Sonapat districts and yields 150-200 m³/hr. Parts of Gurgaon, Bhiwani, and Mahendergarh are underlain by consolidated strata, limiting aquifer output (Haryana Central Ground Water Cell).

Out of 33 blocks in the subregion, 22 are over-exploited, 4 are semi-critical, and 7 are critical according to Ground Water Status. Haryana Sub-Region block-wise ground water status:

Table 1.1: Categorisation of Blocks in Haryana Sub-Region

District	Gurgaon	Mewat	Faridab	Palwa	Jhajjar	Panipa	Rew	Roht	Sonepa
BLOCKS	Semi-					Bahadurgarh Salhawas		Rohtak Lakh	
	Critical		Punhana	Ballabhath	Hathin	Jhajjar	Jatusana		Gohana Kharkhoda
	Over-	Farukhna gar Gurgaon Pataudi Sohna	Taoru Feroze pu- Jhirka	Faridaba d	Hodel Palwal Hassan pur		Bapoli Israna Madla uda Panipa	Nahar Rewari Raw	

Ground Water Table in Haryana Sub-Region: Within the Haryana Sub-region, the average depth of the groundwater table was found to be 16.3 metres in the Rewari District, followed by Gurgaon (15.2 metres), Panipat (13.5 metres), and Faridabad (12.3 m). In the remaining areas, the depth of the groundwater table varied between 4.60 and 6.15 metres. In terms of temporal

shifts in the level of the groundwater table, the Panipat District has seen the greatest reduction, with a net drop of 2.5 metres in the span of four years (2007-2011) or 0.6 metres per year, while Gurgaon has seen the second-most shift (2.2 m or 0.5 m per annum). Other districts in the Haryana Sub-Region, such as Faridabad and Sonapat, also saw a drop in the average groundwater table (0.1 m and 0.2 m respectively). The rest of the districts, including Jhajjar, Rewari, and Rohtak, all saw an increase in water table, with Rewari having the highest level recorded (1.8 m i.e 0.5 m rise per annum).

Conclusion

The rate of depletion is approximately 0.529 metres per year on average. The vast quantities of tubewells that have been drilled into the earth by the farmers in the region are a glaring indicator of the widespread extraction of groundwater. This has alerted farmers to an unsettling dilemma, which is caused by the fact that the rising water table is driving up the cost of installing tubewells, as well as maintaining and operating them. According to the findings of this study, the lack of rainfall in the area under investigation has led farmers to rely mostly on groundwater to satisfy the water requirements that their crops have. The amount of water available has decreased to the point where, in many instances, aquifers no longer provide enough water to fulfil the requirements of the market. As a direct consequence of this, the water table has been falling at an accelerated rate, and its depth is now anywhere from seven to more than forty metres. The continuing trend of falling water levels is a source of grave concern for governmental bodies as well as agricultural organisations. In the event that these tendencies are allowed to persist for an extended period of time, a water crisis will become obvious in the area. In order to find a solution to this issue, corrective measures will need to be implemented not only by the farmers in this region but also by the managers, who may include the government and financial institutions that are involved in the administration of water resources. To make this potentially disastrous scenario in the region more manageable, one of the most workable solutions would consist in irrigating an ever-increasing portion of the land with canals. The collection of rainwater and the artificial recharging of aquifers should both be encouraged in order to enhance the size of groundwater reservoirs and ponds.

In addition to the issue of depletion, the increasing demand for water, as well as the competition for it among different industries, made the implementation of integrated management strategies necessary. Irrigation and agricultural practises were taken into consideration as two of the most important components of ecological strategy. Farmers have been pumping groundwater in the most unsystematic and unplanned manner due to the restricted availability of surface water. In this way, excessive extraction has led to the destruction of the ecological system in the region. The following solutions have been proposed in order to achieve success in overcoming this obstacle: (i) a shift in the pattern of cropping; (ii) an increase in awareness regarding the effective use of water; (iii) the conjunctive use of water; (iv) rainwater harvesting and the creation of artificial losses; (v) a decrease in losses during conveyance; (vi) a decrease in losses during application; and (vii) the distribution of water resources. It is possible that the depletion can be stopped, at the very least to some extent, if these techniques are implemented.

Recommendations for enhancing the quality of the Ground Water Table in selected Sub-Region in Haryana state are given below :

Gurgaon District

- Rooftop rainwater collecting technology should be utilised in order to safeguard the lowering trend of water levels in the district. Additionally, recharge structures should be developed in depression areas where water gets deposited during the rainy season. Because of this, the ground water reservoir will be refilled more quickly.
- Building bylaws in all of the blocks should include provisions requiring the installation of roof-top rainwater collection devices. This will assist in reversing the trend of declining water levels in the district.
- The old dug wells that have been abandoned can be cleaned up and put to use for recharging the ground water by taking advantage of the surface runoff that occurs during the monsoon season.

Jhajjar District

- In the Jhajjar District, waterlogging can be prevented by taking the appropriate steps to lower the rate of recharge to the phreatic aquifer in the affected area and raise the rate at which it discharges water. The construction of surface drains, the lining of canals and water courses, village ponds, the most efficient use of irrigation water, afforestation along canals, drains, rails, and roads, and the pumpage of ground water to drains and canals are some of the remedial measures that have been suggested.
- Changing the cropping pattern from high water intensive crops to low water intensive crops like maize, wheat, and pulses may help prevent water logging. These crops include: maize, wheat, and pulses.
- The areas that are permanently flooded, particularly those that are located along the edges of canals, roads, drains, and ponds, can be employed for the development of fisheries.
- It is possible to drill shallow to deep tube wells in the most southwestern section of the area, reaching depths of up to 80 metres.

In the event of shallow tube wells, a pipe assembly made of PVC could be employed instead.

- It is necessary to notify the Jhajjar (stage of development 113 percent) and Salahwas (stage of development 105 percent) blocks of the district for registration of all ground water abstraction structures. Prior permission should also be sought from the Central Ground Water Authority before the construction of any tube well. The local populace will need to be taught about the implications of drawing water from the ground and the necessity of doing so for economic use.

Sonapat District

- The construction of shallow tube wells in regions near the active flood plains of the Yamuna that have a shallow water level can assist in increasing the available water supply in the area.
- In order to lessen the impact, certain regions that have been noticing a drop in water levels will need to be delineated, and rainwater collecting and artificial recharge procedures will need to be implemented on a large scale.

- Improvised subsurface drainage systems are utilised in regions that have shallow water levels and salt in the soil water.

Rohtak District

- Fish and prawn farming might be encouraged in saline water
- Awareness should be spread towards water conservation
- A separate agency or department could be created with technical staff from the concerned disciplines so that the water logging problem in the area may be tackled in a proper way.

Panipat District

- It is necessary to notify the district for regulation of all ground water abstraction structures, and the construction of any tube needs to be approved by the Central Ground Water Authority. This is required in order to comply with the regulations governing ground water abstraction.
 - Since natural recharge is insufficient to support such significant ground water extraction, it is recommended that artificial methods of ground water recharge be implemented in order to prevent the ground water level from falling much more.

Faridabad District

- In the Faridabad District, it is possible to cultivate crops with lower water requirements in place of crops with higher water requirements.
- Building bylaws for the town of Faridabad should include provisions requiring the installation of rainwater collection systems on the rooftops of all new constructions.
- The old dug wells that have been abandoned should be cleaned up and put to use for recharging the ground water by making use of the surface monsoon runoff.
- The concurrent use of groundwater and canal water of variable quality, which is mixed together in varying proportions.
- The recurrent use of water from canals and the low quality of the groundwater.
- The dug wells that have historically been utilised for the purpose of monitoring the water level in the area have either dried up or been abandoned in significant portions of the **Rewari District**.

Therefore, it is advised that shallow piezometers be installed.

- The water level ought to be monitored carefully, and readings of it ought to be taken at a variety of locations around the area. For this purpose, regular monitoring of ground water level should be accomplished by constructing 20 piezometers with a diameter of 152 millimetres (6 inches), 10 of which should be shallow (30 metres) and 10 of which should be deep (50 metres). These piezometers ought to be dispersed evenly over the area.

It is possible to map locations with high levels of fluoride and educate the public about the detrimental effects fluoride has on the human body. It is possible to use compact defluoridation plants, and water mixing is another something that can be done.

- It is necessary to notify the entire district for the registration of all ground water abstraction structures, and prior permission should be sought from the Central Ground Water Authority before constructing tube wells. This is required before the registration of any ground water abstraction structures.

- In order to alleviate pressure on the ground water, the construction of additional irrigation canals is strongly encouraged.

Mewat District

- The drainage of an excessive amount of surface runoff in the Mewat District
- The construction of shallow bore wells to achieve the same level of annual recharging. This will prevent the water table from rising too high and will lessen the impact of any evaporation that does occur.
- The planting of eucalyptus trees is permitted in areas where the depth of the water table is less than five metres. Both lowering the water table through rapid transpiration and providing economic support to local farmers will be accomplished as a result of this action.
- The management of irrigation by means of canals carrying fresh water Using the salty ground water for irrigation should be stopped immediately.
- Insist that the Taoru block and the Central Ground Water Authority be notified of and give their approval for any and all ground water abstraction structures that are built, as well as the installation of any tube wells. It is important to educate the local population about the implications of mining ground water as well as the necessity of using it for economic purposes.

Palwal District

- In order to stop the declining trends of water levels in the block, the technology of rooftop rainwater harvesting should be adopted, and recharge structures may also be constructed in depression areas where water gets accumulated during the rainy season. This would be a double measure to ensure that the problem is resolved. This will assist in improving the rate at which ground water reservoirs are recharged.
- The old dug wells that have been abandoned can be cleaned up and put to use for recharging the ground water by taking advantage of the surface runoff that occurs during the monsoon season.
- The concurrent use of groundwater and canal water of variable quality, which is mixed together in varying proportions.
- In the overexploited block, it may be possible to grow crops that require a lower quantity of water in place of crops that require a higher quantity of water.

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